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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

ANNUAL INVESTIGATIVE REPORT FOR 1926

and

PROGRAM FOR 1927

NORTHERN DISTRICT
AND
NORTHERN ROCKY MOUNTAIN FOREST EXPERIMENT STATION
MISSOULA, MONTANA

GOVERNMENT PRINTING OFFICE

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ANNUAL REPORT OF DISTRICT 1 INVESTIGATIVE COMMITTEE FOR 1926 AND PROGRAM FOR 1927.

PERSONNEL OF THE COMMITTEE

The annual meeting of the Investigative Committee of District 1 of the Forest Service was held at Missoula, Montana, January 13, 14, and 15. The voting membership of the Committee consisted of:

Fred Morrell, Chairman	District Forester
Elers Koch	Management
W. W. White	Management
S. V. Fullaway	Products
H. R. Flint	Operation
T. Lommasson	Grazing
D. S. Olson	Planting
C. D. Simpson	Forest Supervisor
H. T. Gisborne	Experiment Station
R. H. Weidman, Secretary	Experiment Station

Other Forest officers in attendance were W. G. Wahlenberg and Robert Marshall of the Experiment Station. In addition, the Committee had the benefit of the attendance of the following: J. E. Evenden of the Bureau of Entomology; S. N. Wyckoff of Blister Rust Control; J. M. Sherier and E. M. Keyser of the Weather Bureau; Dean F. G. Miller of the University of Idaho; Dean T. C. Spaulding, Professors Skeels, Ramskill, and Cook of the University of Montana.

The presence of the representatives from agencies outside the Forest Service served to bring to the Committee first-hand knowledge of their Forest research activities. In this way steps could be taken to avoid duplication of efforts and to secure better co-ordination and co-operation.

MATTERS OF GENERAL INVESTIGATIVE POLICY

Termination of Planting Research

According to the action taken last year, planting research came to an end as a full-time activity March 31. At that time Planting funds were withdrawn from the support of the position and Mr. Wahlenberg was transferred to the Southern Experiment Station. Planting will hereafter set up sufficient funds for about three months' work a year on the part of an Experiment Station man in carrying out some of the investigations which Planting will find necessary from time to time.

Need for Grazing Research

With the resignation of McGinnies last fall, the funds which supported the grazing research position in District 1 were withdrawn. The Committee feels that there is a need for fundamental grazing studies in this District

and that a man should be assigned here to carry on the work upon which McGinnies was engaged the last two or three years. McGinnies established a number of valuable permanent experiments which cannot be given periodic examinations by the District organization and the value of which will be lost unless they can be followed up.

Entomological Investigations Needed

The Committee believes that the Forest Insect Station at Coeur d'Alene, which now devotes practically all its efforts to the study and practice of control measures, will never thoroughly meet the needs of the region until it has more adequate provision of funds for conducting entomological investigations. Every year questions arise in the Investigative Committee Meeting which the representative of the Insect Field Station states can only be solved by research.

Fire Studies Conference

The general feeling of the Committee was that the proposed conference of fire-studies men would be desirable. There was some difference of opinion as to when and where the meeting should be held and who should comprise the men attending it. The suggestion was made that it would not sufficiently cover the subject to have representatives only from Districts 1, 5, and 6, in view of the contributions to fire studies on the part of the Northeastern and Appalachian Stations and the Products Laboratory. Several men expressed the opinion that there should be two meetings - one in the East and one in the West. In general, the Committee favored a small meeting of the western men, including the fire chiefs and the fire-studies men of Districts 1, 5, and 6, and also the fire-weather research men of the Weather Bureau in these regions. As for the time of the meeting, it was suggested that if it be held at Madison it should be in the spring and that if it be a western meeting, held possibly in Portland, it could advantageously be held either in spring or fall.

Experiment Station Men on Fires

Like all other Forest Service activities in District 1, Research suffered seriously from interruptions in its field work due to the disastrous fire season of 1926. Altogether, the Experiment Station men spent 5 man-months fighting fire. Although it is questionable whether the highest efficiency is served by keeping Research men on fires for protracted periods in a normal fire season, as was done for nearly 4 man-months in 1925, there is no doubt that in such a grave emergency as last summer the Research man should be mobilized along with all other available Forest officers in the region.

One of the serious consequences of protracted interruption of Experiment Station field work is that the loss cannot be readily made up later in the season, because the forestry students who are depended upon as field assistants must return to school in late September. Suitable field assistants are difficult and often impossible to secure for a short term of employment in the fall. Sometimes a piece of field work must be done at a

certain time or not at all. For the last two years there has been an urgent job of this sort on the program, requiring action in the middle of the summer, which it has been impossible to accomplish in 1925 and 1926 because of the absence of the Station men on fires.

Progress in Establishing Permanent Sample Plots

One of the real needs in the western white pine type has been permanent sample plots for determining by controlled observations just what happens in the way of seeding, germination, mortality, and establishment of reproduction: what sort of growth and loss takes place in residual stands after cutting; and in the case of yeild of the complex young white pine stands, what are the changes due to differences of growth, tolerance and mortality of the species. Previous to five years ago there were only 10 permanent sample plots in the white pine type, most of which were devoted to thinning. These have gradually been built up to a total of 47 plots and 200 reproduction quadrats. A special effort was made in this work in 1926 when 15 of the larger plots and all the reproduction quadrats were established. Of the total number of plots 28 are devoted to yield, 11 to thinning, 4 to methods of cutting, 2 to reproduction after fires, 1 to testing out some 20 strains of western yellow pine, and 1 to a study of virgin-timber conditions. The need is for strengthening the permanent experiments in reproduction and methods of cutting. The program of work for next summer provides for this.

Status of Office Work

The start made on the part of the Experiment Station last year in an effort to catch up on office work is continuing through this year. So far as reports are concerned the situation is as follows:

In fire studies the office work is abreast of the field work due partly to much needed assistance in compilation of weather records by Forest officers assigned by the District Forester for an aggregate of 2½ months. Gisborne's manuscript for Departmental publication entitled "Measuring Forest Fire Danger in Northern Idaho" has been through a board of review and revised, and is now in the hands of the editor. One report by him on lightning fires was recently published and another dealing with observations on a going fire has just been accepted for publication.

The office work of planting research was entirely up-to-date when Wahlenberg left this Station at the end of March. By that time he completed the last two reports on major projects and also prepared a memorandum on the status of numerous minor projects. Several reports of his have been submitted and published during the year. His manuscript for Departmental publication, "Investigation in Chemical Weed Control at Savenac Nursery," is now in the hands of a board of review. Two reports just finished will shortly be submitted for publication in The Journal of Agricultural Research. These are "Experiments in the Use of Fertilizers in Growing Planting Material at Savenac Nursery" and "Experiments with Classes of Stock Suitable for Forest Planting in the Northern Rocky Mountain Region." One report which still remains to be written is necessarily deferred awaiting the next examination of field-planted stock in the fall of 1927. It will deal with

modifying root systems in the nursery to secure better field survival. The District 1 planting bulletin being prepared by Olson will be completed this spring.

In order to have all of Haig's field data on the normal-yield study and the study of old timber-sale areas compiled and made available in the form of reports before he leaves for his furlough for a year's graduate study next September, it will be necessary for him to continue office work possibly throughout the summer.

Larsen still has three reports in various stages of preparation. "Conifers of the Northern Rocky Mountains" has been reviewed by several men here and by both an entomologist and pathologist for the portions of it touching on those special fields. It is now in final draft for review by Weidman. During the year Larsen submitted his report on "Forest Types and Their Climatic Controls in District 1." A preliminary review of this report shows it to duplicate much of the material in "Conifers of the Northern Rocky Mountains," as well as some of the phases of a report which is still to be prepared entitled "Physical Factors of Site in Northern Idaho." This means correspondence with Larsen with a view of eliminating the duplications and will probably mean another year before these reports can be finished.

Weidman has three back reports. The Whitman sample plot report is in preparation, the public requirements report has been partially revised and will be finished later in the spring, and the yellow pine bulletin will be undertaken after that. Another outstanding report is the proposed bulletin for western white pine, of which the Rockwell manuscript will form a nucleus. There is very urgent demand for a white pine bulletin in this region and it is planned to undertake the preparation of this next winter.

A report by Kempff on the 10-year-old thinning plots at the Experiment Station could not be finished last summer as promised, due to lack of time on his part and inadequacy of the volume tables. With the preparation of second-growth volume tables by Haig this winter, it will be possible to finish the computations of this report and have Kempff prepare the article upon his return from his year's leave of absence. As summer is an exceedingly difficult time for report writing on the part of a field officer in Kempff's position, it may not be possible to submit this report until next fall.

A special effort has been made by the Experiment Station this year to catch up with past field work and to keep the office work abreast of current field work. In doing this special help was hired for the office work and paid for out of lapsed salary money and to some extent out of our slim margin of funds available for miscellaneous purposes. In this way we secured $7\frac{1}{2}$ months' office help and through the assignment by the District Office of men on weather and lightning-study compilations, we secured an additional $2\frac{1}{2}$ months' help. The hired help permitted bringing to date computations in connection with our permanent sample plots, but chiefly in connection with computations for the white pine yield study. This was made possible chiefly through the lapsed salary money of two members of the staff who were absent on furlough for an aggregate of 11 months. Such an expenditure as this would ordinarily not be possible. In order to keep up the office work the situation

really demands a second clerk for at least a six months' period each year.

Idaho Senior Class in Forestry at Experiment Station

The senior field trip of the University of Idaho Forestry School was made to the Priest River Station in May, 1926. An intensive program of field instruction in forest investigations and timber-sale practice was carried out for two weeks under the guidance of Dean Miller and three members of the Experiment Station staff. On the two days devoted to timber-sale marking and inspection Forest Supervisor Whitham and several of his force led in the instruction. The senior class contained 11 students. Except for briefly outlining the program and its purposes, there were no lectures. The purposes and methods of each project undertaken in the field were explained on the ground. Instruction was by actual performance of the job under the intensive supervision of the staff.

The program was briefly as follows: 1 day showing the party the main experiments under way on the demonstration forest; 2 days establishing permanent yield plots in white pine and Douglas fir stands; 2½ days marking, felling and slash disposal on thinning plots; 1 day on a study of reproduction following forest fire; 1 day conducting a reproduction and seed-tree study on an old timber sale; ½ day on fire studies; ½ day on office methods in yield and reproduction studies; 2½ days on marking, slash disposal and inspection of timber sales on the Kaniksu Forest.

Although the emphasis in this course of field training was on investigative methods and purposes rather than on the labor and routine of research, the Experiment Station really got a satisfactory return in studies and experiments accomplished. Five permanent sample plots were established and two reproduction surveys were made, one embracing 76 temporary quadrats on a burn, and the other 90 similar quadrats on a timber-sale area. All this work was on the regular program of the Station. Aside from these concrete results, the experience demonstrates the possibilities existing at an Experiment Station in the way of personnel training in investigative thinking and methods such as are useful in any line of forest work. From the side of the forestry school it may be said that Dean Miller recently asked whether he could not plan on the same arrangement for his spring field trip in 1928.

RESULTS AND PLANS OF CURRENT PROJECTS

Seed Studies

Aside from the regular seed testing in the greenhouse there was no activity on seed studies during 1926.

Nursery Practice

There were 5 projects of this sort which received attention during 1926: Chemical weed eradication, stimulation of growth of Engelmann spruce, soil fertility, root control, and hardening off of stock to secure better field survival.

After 10 years of successful experimentation the chemical weed-eradication project was brought to a close with a final report which has been submitted for Departmental publication. Zinc sulphate treatment worked out by this project has been used as regular weeding practice in the Savenac Nursery for several years and has effected a very considerable saving as compared with hand weeding.

The experiment in stimulating the growth of Engelmann spruce in the nursery was also brought to a close in 1926. The final report for publication has been prepared. The results show that by proper fertilization and watering more than a year's time may be saved in the 5 or 6-year period formerly necessary to produce suitable planting stock of this species.

The declining fertility of the soil in Savenac Nursery has been a source of anxiety for several years. Soiling crops and moderate seedling cropping do not seem to be sufficient to keep up the fertility. Compost and manures cannot be obtained locally and commercial fertilizers seem to be the solution. Preliminary experiments several years ago, with a few fertilizers like blood and bone, led up to an experiment established in 1925 in which about 100 small plots were fertilized differently and sown chiefly to yellow pine. Thirty common fertilizers, fertilizer ingredients, or mixed fertilizers were tried in two strengths - a light and a heavy dose. Selection of suitable doses to be tested was based on the results of various experiments with other crops at agricultural experiment stations. Without giving the results for the whole series, it may be stated that the following were among the most effective fertilizers: "Dia lawn dressing, "blood and bone," ammonium sulphate, vegetable fertilizer and potassium nitrate. Among the less effective were: hydrated lime, gypsum, calcium superphosphate, softwood ashes and potassium carbonate. The strongly nitrogenous materials were most effective. To some extent, however, the seedlings responded to all the fertilizers tried and showed superior development in all respects except in balance, the tendency being toward increased top-heaviness. The experiment has narrowed the choice down to a few of the most effective fertilizers which can now be used for administrative experimentation on a larger scale in the main nursery. A final report on the intensive fertilizer experiments has been prepared and will shortly be submitted for publication.

Experiments in an effort to control root development in the nursery have shown that plants with a large portion of their total absorbing root surface between 4 and 8 inches below the ground are the most desirable for highest survival in field planting. Layers of rich and less rich soil of various depths were used to determine how root production might be stimulated in the desired zone. The results indicate that more roots are produced in and just below a rich layer at certain depths than above. Plants so grown were quite different from those raised in unfertilized and uniformly fertilized soil. Trees that were field planted from the various plots showed that those with many roots from 4 to 8 inches deep had twice as many survivors as those from the other plots. Although a commercially practicable method of producing a rich layer is not known, it may be developed administratively in the nursery. In an effort to secure root development in the desired zone by other means, 4800 trees of 1-2 yellow pine stock were

transplanted last spring in four different ways involving root pruning and depth of setting. It is too early to report on this phase of the experiment.

The experiments in hardening off of stock also aim to fit plants better for survival under the severe conditions of field planting. Three lots each of western white pine and western yellow pine stock were given treatment as follows: (1) no irrigation after July 15; (2) no irrigation after August 15; (3) no irrigation after September 15. Each of these was again subdivided into two lots: one sheltered from all rain until September 15, and the other not so sheltered. The control lot of trees received normal irrigation and no shelter. From stock so treated field planting was done in the fall of 1926.

There are forest school nurseries at both the University of Idaho and the University of Montana. Several student research projects are carried on at each institution. At Moscow a study of the effect of not using winter mulch on western yellow pine seed beds was initiated in the fall of 1926. This spring a project trying out chemical weed eradication and one dealing with shading of seed beds will be started. At Missoula an experiment is in progress dealing with the factors governing germination of tree seeds in the laboratory and in the nursery. Experimentation is also being carried on in the growing of native and exotic trees for forest and shade-tree planting in various parts of the State of Montana.

Sowing and Planting

The chief activity under this heading during the year dealt with studying the influence of brush in aiding survival of field-planted stock. Last spring nine hundred 2-2 western white pines were planted systematically under and adjacent to willow bushes on a northwest slope. Examination last fall showed rather high survival in all cases with very little difference between plants under the bushes as compared with those in the open. Eighteen hundred 1-2 western yellow pines were planted under and adjacent to Ceanothus bushes on an east slope typically covered with Ceanothus velutinus. Instrumental measurements of meteorological and soil conditions on this site showed that soil moisture became exhausted in the open several weeks previous to the August rain that ended the prolonged period of drought and that some available soil moisture still remained under the bushes. This checked well with the survival results revealed by examination on August 20, which were: 89 per cent alive under the bushes as against 53 per cent alive in the open. Thus Ceanothus brush seems to favor the survival of yellow pine in its first year after planting on severe sites. Observations of natural reproduction on brush areas indicate that although seedlings may be suppressed for several years they will eventually overtop the brush.

Methods of Cutting

The Experiment Station has one project under this heading. This is confined to the western white pine type and has two phases; one dealing with the intensive study of conditions on old timber-sale areas, and the other with permanent sample plots established at the time of cutting and examined periodically thereafter. Six weeks of field work were given to the project

in 1926 and the greater part of this was devoted to the establishment of three permanent sample plots.

These permanent plots are located on the West Branch of Priest River and are 1, 2, and 10 acres in size. The largest plot represents excellently the standard marking practice with thrifty and uniformly distributed seed trees of white pine and a light residual stand of cedar and hemlock. The two smaller plots represent the method now in vogue on the Kaniksu Forest of treating old mature and defective white pine-hemlock-cedar stands which are close to the climax stage. The defective hemlock was felled and burned, and about three white pine seed trees left per acre, the object being to reduce the heavy shade of the stand sufficiently to secure white pine reproduction. The purpose of the two hemlock disposal plots was in one case to determine whether and how white pine reproduction is secured, and in the other case (where there was a considerable second-story stand of younger and sound hemlock, cedar and white fir) to ascertain primarily whether a second cut can be secured in this stand and secondarily whether white pine or other reproduction can be secured under it.

The timber marking was done by the regular Forest officers, and the plots were established in the first year following logging. The seed trees and all residual trees on the plots were tagged, measured, and described. These will be remeasured at 5 or 10-year intervals, but their seed production will be observed annually. In order to follow the germination, mortality, and establishment of reproduction, 140 quadrats of mil-acre size were located on the three sample plots. These are permanent quadrats, and were mapped and described for soil, humus, duff, and ground cover. The seedlings already started on them were marked with individual wire stakes, and this will be done at each of the annual autumn examinations in order that the record of germination, loss, and establishment may be kept in relation to seed crops. Without going into the reasons therefor, it may be stated that 50 seedlings per acre were found on the hemlock disposal plots and 280 seedlings on the plot representing standard marking conditions.

A very incidental amount of work was done in 1926 on the Experiment Station's study of old timber sales. In this study temporary strips are run across the areas on which reproduction quadrats are taken at intervals and the trees of the residual stand are tallied and bored for increased growth. Seedlings on the quadrats are analyzed for age, species and number per acre. In 1926 only two areas were studied, both on the Kaniksu Forest. Including the work done on this study in 1925, altogether 15 old timber-sale areas have been examined intensively. The data on six of these have been analyzed and presented in a preliminary report which has been made available to the Supervisors of the Kaniksu and Coeur d'Alene Forests. The compilation of the field data on the remaining areas will be undertaken in the latter part of the present office season.

The establishment and annual examination of permanent sample plots is a continuing project. Altogether, there are now only four methods-of-cutting plots, the three established last year and one installed by Brewster several years ago. It is planned to establish at least six plots next summer in the Priest River and Coeur d'Alene experimental centers. Thereafter such additional plots should be established as will be necessary to represent

reasonably the different methods of cutting and the various conditions prevailing in the white pine type. Time must also be devoted next fall and each year thereafter to the annual examination of seed trees and reproduction quadrats on the plots already established. Although it was hoped to do another season's work next summer on the intensive study of old timber-sale areas, this must be postponed a year in view of the extended furlough to be taken by one of the members of the staff.

The Office of Management started its project of systematic surveys of timber-sale areas to be conducted by local Forest officers. The instructions require: (1) A complete record of conditions existing at the time each sale is closed, including a 10 per cent cruise of the residual stand and recording of estimates and stand tables. (2) Periodic examinations of cut-over areas at 5-year intervals, including the tallying along strips of established reproduction by species and number per acre. It is not expected that this examination of cut-over areas by the Forest force will replace the more detailed and scientific work done by the Experiment Station. It will, however, serve to train the local men in the study of results of silvicultural methods, and give the District some general and large-scale information on the success or failure of the cutting methods practiced. Very little was accomplished by the Forests last summer and fall, owing to the press of fire work and the subsequent salvage of fire-killed timber. The work will be stressed next year and will be given personal direction by the Management organization.

Several Forests are attacking the defective hemlock problem to determine the efficacy and costs of different methods, such as girdling, felling, and a combination of girdling and felling, with disposal of the debris by burning broadcast and in piles. Two of the Experiment Station plots are located on hemlock disposal areas and additional study will be devoted to the problem.

The University of Montana Forestry School has made observations of the results of various methods of cutting on the Stillwater State Forest. This area has been logged, intermittently for 20 years, having been culled in turn for saw timber, stulls, ties, poles, posts and fuel wood.

Natural Reproduction

There is one Experiment Station project dealing chiefly with the study of reproduction after forest fires. Larsen's transect studies of old burns furnished an excellent background for the present phase of the work of establishing permanent sample plots. In 1926, 60 permanent reproduction quadrats were located on the Experiment Station burn. Although this area is now four years old, the reproduction can still be readily analyzed for age and the establishment of the experiment at this apparently late date was, therefore, justified. Reconnaissance was made of a number of burns of last summer on the West Branch of Priest River with a view to undertaking this work on an enlarged scale next summer. The ultimate object of the work is to determine the factors affecting regeneration in the white pine type, whether after fires or after logging. It happens that on large burns many of the factors are found isolated and ready to study. Four steps are involved in the establishment of reproduction: production, dispersion, and

germination of seed, and the establishment of the seedling. Tagged trees on both burns and cut-over areas will afford the basis for observation on cone production. Quadrats located at regular intervals from seed trees and groups of seed trees will give information on seed dispersion. These quadrats will also furnish the information for the study of germination, loss, and establishment of seedlings. Screened and unscreened quadrats will lead to the determination of whether reproduction arises from stored seed or seed cast by seed trees. The distance to which seed may be carried by the wind will be determined both by seed catchers in burns and by the release of seed at a known height and in different velocities of wind. It is planned to have two or three men spend the greater part of next summer on this study. Tentative arrangements have been made with Mr. Evenden of the Coeur d'Alene Insect Field Station whereby he will spend several days with the Experiment Station men in examining the tagged trees for insect attacks.

The 140 reproduction quadrats already located in methods-of-cutting plots, and those to be established next summer on such plots, will also contribute to the results of this study.

The Custer Forest started a reproduction study in 1923 upon which little work has been done since, due to the press of administrative duties. This project deals with the encroachment of western yellow pine on grazing lands.

Thinning

There are two thinning projects on the program: one in white pine conducted by the Experiment Station, and one in yellow pine conducted by the Custer Forest.

The white pine project comprises 11 plots at the Priest River center, of which four were established in 1914, four in 1919, two in 1925, and one in 1926. The 1914 and 1919 plots were remeasured in the fall of 1924 and the field data have been compiled to the point of computing the board foot volumes. This work is being postponed until the new second-growth volume tables now being prepared at Washington become available. The report will be prepared next fall.

The yellow pine project on the Custer comprises six plots established in 1918 and 1921, a thinned and check plot each in 25, 50, and 100-year-old stands. Remeasurement of the 1918 plots was made in the fall of 1922 and is again due in the fall of 1927. Remeasurement of the 1921 plots was due in the fall of 1925 or spring of 1926. No report received.

Volume, Growth, and Yield

The western white pine yield study is the most important project under this heading. A crew of 3 to 4 men was engaged on this all last summer. As a result of all the work to date, there are now available about 305 temporary sample plots upon which to base the final normal-yield tables. These plots were well distributed over the Kaniksu, Coeur d'Alene, St. Joe, Clearwater, and Lolo Forests. They represent all site conditions and a range in age from 30-160 years. The number of plots is a sufficient basis for the final tables and the field work of this stage of the study is now regarded as complete.

As mentioned in the investigative report last year, one of the great obstacles in working up the yield study has been the lack of accurate second-growth volume tables. For some species there were no volume tables at all and for others the existing volume tables were inaccurate, as determined by a thorough check of them. Still another obstacle was the uncertainty whether site, locality, age, density, and composition did not affect volume tables of the various species occurring in the mixed white pine stands. This necessitated another office study in which the Experiment Station received help from both District Office of Management and the Washington Office of Measurements. The results show that site exerts a very slight influence on form, and thefefore, on volume. The effects of age, density, and composition are also very slight. The study showed some influence of locality on volume but not sufficient to justify a subdivision of volume tables on the basis of locality.

In order to hasten the office work and to make sure of finishing the final yield tables before the next field season, a force of five computing clerks was employed for six weeks last fall. With this help it was possible to start the preliminary compilations for the following second-growth volume tables: white pine, Douglas fir, larch, white fir, hemlock and cedar. The volume tables are to be completed promptly in the Washington Office of Measurements. Except for measurements taken on 150 white fir and 130 hemlock trees last summer, the volume tables are being based on tree measurements already in the files. Tables will be made for: (1) cubic volume; (2) board foot volume, Scribner rule, by total height and number of logs; (3) board foot, International 1/8" rule, by total height and number of logs. In addition to the above work, the temporary computing force did considerable work in arranging the yield data proper for machine compilation. When the preliminary computations were finished here, Haig took all the material to Washington where the entire force of the Office of Measurements gave most of its attention during the winter to the compilation of the data with the idea of finishing the work by spring.

The final white pine yield tables will show normal yield by three sites in cubic feet, in board feet Scribner Decimal C, and board feet International 1/8". They will show this yield for the total stand and for stands including trees 7" and up, and trees 12" and up. The tables will also show trees per acre, basal area, and average diameter. Tables may also be prepared showing values for the dominant stand, i.e., for the dominant and codominant trees only.

Another phase of the yield study is that dealing with permanent sample plots. Such plots furnish the only possible means of studying the developmental changes of stands due to variation in growth, tolerance, mortality, and ascendancy of the species. During 1926 eight permanent-yield plots were established on the Priest River Experimental Forest, bringing the total number to 30 permanent sample plots devoted to this purpose. These plots are about equally divided between the Priest River and Coeur d'Alene experimental centers. Eight of the plots are due for their first half decade remeasurement in the fall of 1927.

In the case of two of the yield plots established last year in a 40-year-old stand, one of the objectives was to determine the efficacy of pruning. On one of the plots all the trees were pruned up to 17 or 18 feet above ground and on the other plot the trees were left unpruned. The idea is to determine

whether the production of clear butt logs in this way will ultimately be feasible. Western white pine retains dead branches along butt logs up to 80 and 100 years, even though these branches are dead by the time the trees are 40 to 50 years old. With the virgin timber gone and with a rotation of about 100 years, there will be little clear white pine lumber, unless pruning is resorted to. When the timber on these sample plots is ready for cutting, it is planned to make a mill study of grades sawed from the pruned and unpruned trees.

In connection with the continuation of yield-study work, the next logical step, from the standpoint of the Experiment Station, would be to make an application study. This would mean field work in stands of various stocking with a view to determining correction factors to be used in applying the normal yield tables to natural stands. In view of the fact that the Experiment Station staff will be short handed next summer, it will be necessary to postpone this study. The only yield-study work planned is the remeasurement of eight permanent plots and the establishment of several new plots in the younger age classes not represented by the existing experiments.

A phase of yield-study work which was proposed in the last year's investigative program was to deal with the problem of the varying proportion of species with increasing age in young white pine stands and its relation to Ribes eradication. It was hoped that this could be undertaken by a diversion of funds from the Office of Blister Rust Control to the Experiment Station. This arrangement did not finally prove feasible. The study is an important one, not only from the standpoint of blister-rust control but from that of yield prediction in general. It is hoped that funds may be made available this year to undertake it.

During 1926 files were set up for the three Service-wide projects: Regional growth, Converting Factors, and Research Methods. Extra copies of material in the way of tables, graphs, forms, etc., pertaining to the subjects were properly placed in the new files.

The Office of Management has a project on the program dealing with increased growth after cutting in lodgepole pine. Three weeks' field work on the Gallatin Forest in 1924 and 1925 yielded increment core measurements on about 1200 trees. A brief progress report was prepared by White in December, 1926. The disastrous fire season prevented additional field work on the project last year. It is planned to do two or three weeks' work on the Deerlodge Forest next summer.

For some time the Office of Management has not been satisfied with the situation with regard to volume tables in District 1. The subject was given considerable discussion during and after the conference of District logging engineers and timber-surveys men held in January, 1927. There has been a gradual but decided growing away from the conventional volume tables on the part of those doing timber estimating and appraisal in this region. For several years the men have been using almost entirely a volume table which consists simply of three columns headed D.B.H., Logs per M, and Scale of Av. Log per Tree. There are three or four such tables for the District, the values of which differ according to the form of the timber being carried. These tables are used on the ten commercial species of the region, and appear to check out fairly satisfactorily. Form as indicated by the scale of the

average log of a tree (derived by dividing its total scale by the number of logs) is the basis of the several volume tables. This is an index of form readily understood and measured by the timber estimators, and yields a volume table, the construction of which they thoroughly understand. These considerations, coupled with the fact that these tables are adapted to the practice of cruising by logs per tree and logs per M, seem to comprise the chief reasons for discarding the conventional volume tables in District 1. Another reason seems to be that the conventional tables compare so poorly with actual checks. It should be mentioned in this connection that timber estimating here is done chiefly by permanent Forest officers specializing in timber work, rather than by inexperienced field assistants as in some other localities.

Although the sort of universal volume tables now being used here have a fairly sound mathematical basis, form (as it varies by diameter classes and localities) has not been adequately studied and allowed for. Moreover, it appears, from a little inquiry into these points, that to allow for them adequately may mean subdivision into a considerable number of tables of this sort. And this would defeat one of the advantages of such tables. It is believed that the solution is either the making of scientifically based form-class tables, or the making over of all the standard volume tables to overcome their present inaccuracies and to put them in form for cruising in logs per M.

A co-operative study of the situation is planned by the Office of Management and the Experiment Station. The 20 or more existing volume tables will be investigated closely to determine why and to what degree they fail of local application. Preliminary checks have already been made of several tables. Except for the collection of original volume measurements by local Forest officers for hemlock, white fir and Douglas fir, for which there are none or insufficient measurements, the task will consist chiefly of reworking existing field records. The new and revised tables will probably be put in both the conventional form and form for cruising in logs per M. The second-growth volume tables now being made by the Experiment Station in connection with the white pine yield study will partly serve District requirements, but will not take the place of the needs here outlined.

The University of Idaho Forestry School has two yield projects on its research program. It should be stated here that this school provides regularly for conducting two months of summer field work in Forest research. Each faculty man is assigned a project and provided with the necessary field assistants. One of the yield studies has been devoted to even-aged second-growth stands and the other to residual stands left after cutting on private holdings. Both studies have been conducted in the white pine type. In the former study Mr. Watson took empirical yield data in 1924 and 1925 on over 200 forties in the St. Joe and Coeur d'Alene region. The work was done by half-chain strips in 20 to 80-year-old stands chiefly outside the National Forests and with the idea of determining what promise these stands hold for the private owner. Yield was predicted for 10-year periods by use of the Experiment Station preliminary yield table. The study of residual stands has been carried on for four field seasons, chiefly by Mr. Nettleton. Temporary sample plots have been taken in typical private cuttings up to 20 years old and increment cores taken from the remaining trees. In 1926 a start was made in establishing permanent sample plots in these projects. Mr. Watson established eight 1-acre plots in the white pine cuttings of the Clearwater Timber Company. The cutting here was done to diameter limits of 12 to 14 inches. The object of the plots is to determine the rate of growth and the

yield that may be expected from the residual stands. Remeasurement is to made at 5-year intervals for 35 years. The establishment of permanent sample plots is to be continued in both projects next summer. It is planned to do part of the work in yellow pine stands on the School Forest near Moscow and part in white pine in the holdings of the Clearwater Timber Company.

The University of Montana Forestry School has several permanent sample plots upon which yield observations are made. These are located in yellow pine stands within a few miles of Missoula. As the school does not attempt to carry on Forest research outside of the school year, there is naturally little activity in the way of field investigations in yield, reproduction, and methods of cutting. Such field work of this sort as can be accomplished takes the form chiefly of problems assigned to advanced students under the supervision of the faculty men. The individual research work of the members of the faculty is performed chiefly in the laboratory.

Fire Studies

There are three projects under this heading: (1) the relation of weather conditions to the inflammability of forest materials; (2) lightning as a cause of forest fires; (3) weather forecasting.

In the first-named study the collection of measurements of each of the weather elements in relation to duff moisture content and inflammability was continued at the Priest River Station in 1926 along the same lines as in previous years. From results obtained in 1926, it appears that duff as a fuel of forest fires is now fairly well accounted for. Future activity on this phase of the work will be largely the refinement and checking of previously acquired information and reduction of this knowledge to routine use. A full report on this subject was given its final revision last summer, after having been through a Board of Review. It is now in the hands of the Research Editor and it is hoped will shortly be on its way for publication as a Department bulletin.

Measurements of the weather elements in relation to moisture content of woody materials were undertaken in 1926. This will be continued next summer and carried on to the point of relating the moisture content of wood to its inflammability. There are more ramifications to this problem, however, than there were in the study of relation between the study of the weather and duff inflammability, and the solution undoubtedly will require several years' work.

Both the University of Montana and the University of Idaho Forestry Schools are co-operating in this phase of fire studies. Prof. Ramskill of Montana is now engaged in a promising study of an electrical method of measuring the distribution of moisture in wood. Prof. Angell of Idaho has prepared a report on the thermal conductivity of wood. And Prof. Hubert of Idaho has a report on the effects of moisture content and kind of rot on the ignition and combustion of rotten wood. The Forest Products Laboratory is also helping on several phases of this problem, Dr. Hawley having made a special trip throughout the Northwest last fall to familiarize himself with the particular features of this problem. The objective of all this work is more accurate knowledge of the fundamental controls of fire

occurrence and behavior, so that we may better know what we are dealing with in our attempts at fire prevention and suppression.

During 1926 Gisborne spent several weeks studying going fires. As a result of this work, and of the similar work done during 1925, a progress report is in preparation and a working plan has been completed to guide future investigations of the same sort. A rather detailed study was made also of the meteorological conditions prevailing during the Quartz Creek fire, and an article on this has been accepted for publication in the Monthly Weather Review. It is worth mentioning here that this study showed very clearly that when temperature and humidity are high and low enough, respectively, to produce a certain dryness of fuels - less than 10 per cent duff-moisture content - then slight variations of wind velocity may cause great variations in the area burned. The exact average temperatures, humidities, and wind velocities responsible for the days of great spread have been isolated from the conditions prevailing on the generally east days so that in the future when the weather forecasts indicate conditions similar to these bad days the probable result may be interpreted in terms of spread of fire. Similar studies must be made under numerous combinations of conditions other than those prevailing on Quartz Creek before complete information is available.

In the study of lightning and forest fires the results of four seasons of record have been compiled, analyzed, and the report published in the Monthly Weather Review. This method of studying lightning storms by the compilation of observations made by the lookouts still holds promise of valuable results. In such a study good records covering ten successive years are none too many. As it is, the records obtained during 1922 and 1923 were decidedly incomplete and rather inaccurate in some respects. The records for 1924 and 1925 were much better, but it is still obvious that until the supervisory force on each Forest becomes interested in this possibility of improving protection, the reports obtained from that Forest will be far from usable. The main points brought out by the published summary are: The value of having each lookout report to his ranger at the first appearance of a lightning storm; the necessity of taking action immediately to prepare for the fires that may be expected; the general characteristics of that storm, hence the chance that it will be a fire-starter; and the value of these records to the Weather Bureau so that they may study the weather conditions which produced the storms and thereby recognize similar possibilities more accurately and a longer time in advance when such weather conditions appear again.

The plan for next year includes a continued drive to get good reports from the lookouts, an analysis of the reports of the exceptional lightning year 1926, and a collection of records by use of Prof. Angell's quadrant electrometer. It will be recalled that this instrument was loaned to the Experiment Station with a view of taking measurements of atmospheric electricity. The instrument was set up at Priest River last summer but could not be made to operate satisfactorily and, due to the absence of Gisborne on going fires, was allowed to remain idle throughout the summer.

In co-operating with the Weather Bureau to assist in improving the forecasts for the forested regions, the Forest Service reported by telegraph each day to Spokane from Priest River, Musselshell, Savenac, and Spotted Bear Stations. The purpose of these reports was to inform the forecaster at Spokane of the actual weather at these Forest stations so that he could modify his forecasts for these four different localities if he thought it advisable. As this was the first year of this experiment, the results were few, except as the reports served to familiarize the forecaster with the differences in weather at these stations. Except for the co-operation with the Weather Bureau, the Experiment Station gave no additional time to the project on weather forecasting. In 1927 Gisborne will again attend to the duties involved in this co-operative project and in particular he will accompany a Weather Bureau representative on an inspection of the various weather stations.

Although the Office of Operation did not carry on any work of a strictly fire-research character in 1926, it was engaged in several activities of a more or less investigative nature. One of these was the hour-control study which has been in progress during the last three years. Field work was completed and hour-control maps of the fire Forests are to be finished by April 1. Another activity was the preparation of maps showing the areas burned over in the National Forests in District 1 during the past 50 years. The striking feature about them is the great percentage of North Idaho Forests and of the Flathead Forest which was burned over during that period. Without yet having planimetered the areas, it is apparent that fully 75 per cent of the gross area of North Idaho Forests has been covered by fire since 1870. The mapping of burned-over areas will be extended to lands other than National Forests. This material, as well as compilations of additional data, represents progress also in the preparation of a District One fire bulletin. Collection and compilation of data for this bulletin will be continued next year.

Cordeau-Bickford or "chain dynamite" was tried out experimentally for opening fire trench. The results are not entirely conclusive but are not encouraging. The explosive is remarkably quick and powerful but unless buried beneath the surface it does not move enough of the duff to make an effective trench.

The trial of Radio Station KUOM, University of Montana, for broadcasting weather reports and general fire intelligence was continued. The efficiency of this methodsof transmitting information appears not to be more than 20 or 25 per cent of possible. There are too few adequate receiving stations in the field, but even at many points where there are suitable receiving stations reception from KUOM is not dependable. Uncertainty as to whether the reports will be received has greatly reduced the interest of the field men in endeavoring to get them. As little expense or trouble to the Forest Service is involved, it is willing to continue furnishing the information if the University wishes to continue the experiment.

The Office of Operation recommends the vigorous pursuit of the three Experiment Station projects outlined in this program. From its point of view they appear to be the most promising leads in fire research at this time. The experience of the past season emphasizes the need of the field for: (1) dependable and adequate means for recognizing in advance the

approach of danger periods; (2) dependable 36-hour or longer weather forecasts; (3) dependable warnings of the approach of lightning storms.

Forest Types

The program contains one type study, the field work of which was finished by Larsen some years ago. Upon the latter's resignation it was agreed he would prepare the two reports he had in mind for this study, one entitled "Forest Types and Their Climatic Controls in the Northern Rocky Mountains" and the other "Physical Factors of Site in Northern Idaho." The former report in draft form was received during the year but a review of it shows a considerable duplication of material in Larsen's "Conifers of the Northern Rocky Mountains" as well as some duplication of that which appears in his physical-factors-of-site report. This means radical revision before the report can be put in final form.

Tree Studies

There was no activity in 1926 on the proposed white pine and yellow pine bulletins. The latter is to be undertaken by Weidman this spring.

Larsen's "Conifers of the Northern Rocky Mountains" was reviewed by several men during the year and now awaits action by Weidman.

Other Studies

Despite the bad fire season it was possible to make material progress in the development of the Priest River experimental forest in 1926. Ten permanent sample plots were established within the demonstration area and two additional plots were located two miles outside its boundary. The sample plots include 8 yield, 2 reproduction-after-fire, 1 thinning, and 1 virgin-timber plot. The two reproduction plots contain a total of 60 permanent reproduction quadrats. The establishment of the virgin-timber plot merely consisted of running its boundaries. This plot is about 125 acres in size and is a typical sample of the climax stage of the white pine type. The purpose is to retain this plot in its virgin condition for all time in order to be certain of having available a sufficiently large body of virgin timber for studies and observations when the present old-growth white pine timber of the region is entirely logged.

The South Ridge trail was completed in 1926, adding another 3 miles to the trail system in the demonstration area. Another job accomplished was the traversing and posting at half-mile points of the existing trails and roads, which now aggregate 20 miles. The slash on the cedar sale on Benton Creek was completely cleaned up last fall by a careful job of piling and burning. Unfortunately the contract for this small timber sale did not call for the felling of snags and defective trees. These detract considerably from the looks of the area and prevent it from being made a model timber sale. It is hoped that the undesirable material can be felled and disposed of during the year.

As a part of the intensive fire protection plan for the demonstration forest, plans have been made for extensive trail construction during 1927. Specifications and estimates for about 16 miles of trails of various standards have been approved and an allotment of $5000 has been received for construction next summer. This work is to be done by the Forest Supervisor. The location work on about half the trail mileage was accomplished last fall and the remainder is to be done the first thing in the spring. With the extension of the trail system planned for next summer, the total trail mileage in the demonstration forest will exceed 30 miles. This will make possible the passage of a trail or road through each quarter-section in the existing 4000 acres of the area. New trails will particularly open up the Canyon Creek drainage to the protection and research men. As now planned, any point on the area will not be over 15 to 20 minutes' walking distance from a road or trail. This will greatly reduce the present hour control.

Fire protection on the demonstration forest at present is afforded by an organization of a district ranger, an office assistant, two smokechasers, two or three resident Experiment Station men, and a small trail-construction crew. In addition, there is the existing 20-mile trail and road system, a telephone line through the length of the area, a primary and a secondary fire lookout point, and full fire-fighting equipment including a modern, portable pump with 1200 feet of hose permanently located at the Experiment Station. Also, there is an experimental firebreak one chain wide and two miles long on the ridge along part of the south boundary of the area.

Although the Benton Creek road was finished in 1924, there have not been favorable conditions for making sales in the body of virgin timber at the head of the creek. It is desirable to make sales in this timber in order to establish methods of cutting plots on the demonstration forest. One of the difficulties in making small sales here is that there is not enough white pine in the stand to move the mixed species except under the most favorable conditions of the lumber market. It is hoped that a sale may be made next winter.

Development of experimental centers in 1926 was confined to the Priest River area. Here the limits of the working territory were extended to the West Branch of Priest River, and hour's automobile travel from the Station, where three permanent methods-of-cutting plots and 140 permanent reproduction quadrats were established during the fall. It is the plan for next summer to establish 2 or 3 additional methods-of-cutting plots in this locality and also to locate here a number of permanent plots of the reproduction-after-fires project. In addition, it is planned to establish several methods-of-cutting plots in the Coeur d'Alene experimental center. It will be recalled that this area already contains 17 permanent yield plots which were established before it was suggested as an experimental center. Eight of these plots will become five years old in the fall of 1927 and will be up for remeasurement at that time.

FOREST PRODUCTS INVESTIGATIONS

I. REVIEW OF RESULTS - 1926.

A. General Statement

The 1926 program as proposed and approved by the Committee has been altered materially during the year and certain objectives have not been attained. Several factors are responsible. The General Products Conference at Madison last spring assigned additional work to the office. The time required to complete certain projects was underestimated, and substantial contributions to District administrative activities were necessary during the year. In view of this condition practically no new activities are proposed for the coming year.

B. Forest Products Investigations

1. Air Seasoning, Project L-257.

The 1926 program did not contemplate any work under this project. At the Madison conference, however, it was decided that the preparation of a Departmental publication on the drying of western softwood lumber, based upon the studies conducted by Districts I, V, and VI, should be attempted during the fiscal year 1927, and the job was assigned to this office.

Considerable progress can be reported on this work. The necessary first-hand knowledge of air-seasoning practice and problems in the Douglas fir, California pine, and redwood regions was obtained during a 7 weeks' trip in Districts V and VI. In addition, a preliminary outline has been prepared and a good start made in assembling the data available.

2. Lumbering Studies

LOGGING OUTPUT - Although some work looking toward the publication of these data was possible, material progress was precluded by the air-seasoning assignment.

SAWMILL STUDIES - During the year, the additional field work planned was accomplished, two articles based on the work were published in the trade journals; and compilation analysis, and preparation for three additional trade-journal articles has been carried forward. Due to an underestimate of the time required and to contributions to Laboratory work and Fire, this project has not been completed as planned.

3. Wood Preservation

SERVICE TEST INSPECTIONS - The program outlined was accomplished with one exception. A joint inspection of Project L-44 by the Laboratory and the District was postponed until 1927 due to the impossibility of the Laboratory to participate this year.

PRESERVATION OF FENCE POSTS, Project L-263. Although the time required by this project was considerably greater than anticipated, the field work and preparation of a detailed report on this project were completed. Four distinct treatments were employed. More than 1100 fence posts were involved and these included five species of local timber. In addition to the service-test data which will be obtainable, a great deal of information was secured as to penetration, absorption, length of treatments, etc.

4. Little-Used Species, Project L-264

WESTERN LARCH - A final report on this work was prepared in the form of a memorandum for the files, which brings together all the available data on the problem. Its purpose is twofold; to provide the Laboratory with everything which may be of value in the preparation of the "Properties and Uses" bulletin for larch, and to afford the basis for future work which the District must carry on with the producers. Preparation of a trade-journal article dealing with the utilization of western larch is being delayed until the "Properties and Uses" publication is ready for the press.

WHITE FIR - The status of this work is the same as that of the larch. A final report has been prepared and a trade-journal article will be written later.

LODGEPOLE PINE - Initiation of this project was necessarily deferred. It is planned to make this a major activity during 1927.

C. Forest Economic Investigations

All work programmed under this caption for 1926 was carried through to completion in the usual manner.

D. Publications

1. Monthly Summary of Trade Conditions.

   Issued regularly to the Forests.

2. Do you Treat your Fence Posts? By C.N. Whitney.

   Published in the April 25, 1926, issue of the Utah Farmer.

3. Production of Lumber and Other Timber Products in Montana and Idaho during 1925.

   A press notice prepared by C. N. Whitney.

4. The Depreciation in River Logs, by M. Bradner.

   Published in the January, 1926, issue of the TIMBERMAN.

5. The Moisture Content of Air-Seasoned Lumber in the Inland Empire, by S. V. Fullaway, Jr.

   Published in the February, 1926, issue of the TIMBERMAN.

6. The Forests and Forest Industry of Idaho and Montana, by S. V. Fullaway, Jr., and R. N. Cunningham. Published in the May, 1926, issue of the West Coast Lumberman.

7. Log Scale versus lumber tally by M. Bradner, and Philip Nerf.

   Published in the July, 1926, issue of the TIMBERMAN.

8. The Montana Forest and Timber Handbook by R. N. Cunningham, S. V. Fullaway, Jr., and C. N. Whitney. Published by the Montana Forest School.

9. The Idaho Forest and Timber Handbook. Manuscript prepared during the year. Publication by Idaho Forest School expected by July, 1927.

II. PROGRAM OF INVESTIGATIONS - 1927.

A. Continuing Projects.

1. Air Seasoning, Project L-257.

The preparation of the proposed Departmental publication "The Air Seasoning of Western Softwood Lumber" will, it is hoped, be completed prior to July 1, 1927.

2. Lumbering Studies.

LOGGING OUTPUT - It is again proposed to prepare a new presentation of the Logging Output manuscript for publication as a Departmental Bulletin.

WOODS UTILIZATION STUDY - This project will be initiated according to plans presented in the 1926 program.

SAWMILL STUDIES - Preparation of three additional trade-journal articles will complete the reports necessary to present all field data now available.

At the request of Forest Management, additional work will be carried on under this project during 1927. In order to determine the depreciation occurring in fire-killed white pine, a two weeks' field study will be made at the Dalkena Lumber Company's mill. Depreciation in both 1925 and 1926 fire-killed timber will be determined at this time. The compilation and analysis of the data secured and a comparison with data on green timber already available for this mill will necessitate a large amount of additional office work. Results will probably be published as a trade-journal article.

3. Wood Preservation.

Service-test inspections will be made as follows:

Project L-44	Mine Timbers, Poles, Posts, Ties	A.C.M. Co.	Butte, Montana
Project L-50	Railroad Ties	N. P. Ry. Co.	Plains, Montana Thompson Falls
Project L-214	Pole Stubs	Lewis & Clark Nat'l. Forest	Choteau-Ear Mt. Telephone line
Project L-214	Poles	Beaverhead National Forest	

4. Little-Used Species, Project L-264.

WESTERN LARCH - Preparation of a trade-journal article dealing with larch utilization.

WHITE FIR - Preparation of a trade-journal article dealing with white fir utilization.

LODGEPOLE PINE - This study will be a major project during 1927 and field work and report will be pushed as rapidly as possible. It is planned to publish the results of this work in the form of a Departmental bulletin.

5. Annual Lumber Census.

6. Prices.

a. Lumber-mill.
b. Lumber-retail.
c. Stumpage.
d. Log.
e. Cedar products.
f. Ties.

7. Lumbering Costs.

a. Logging.
b. Manufacturing.

8. Timber Survey of Private Lands.

B. New Projects

The Forest Products Laboratory has initiated a general "Moisture Content" project. A certain amount of work along this line will be necessary in the western lumber-producing regions and of course the District Products Offices should handle this phase. Accordingly, this project is placed on our program, since all work in the Inland Empire will be done by this office.

D. Publications.

1. Departmental bulletins.

   a. Air Seasoning of Western Softwood Lumber.

   b. Logging Output.

2. Trade Journal Articles.

   a. Sawmill Methods and Equipment in Relation to Quantity and Quality Production.

   b. Sawmill Utilization.

   c. Production Costs versus Mill-Run Values for Logs of Varying Size and Defects.

   d. The Depreciation of Fire-Killed White Pine.

   e. The Predicament of Western Larch.

   f. The Utilization of White Fir.

3. Miscellaneous.

   a. 1926 Lumber Production of Idaho and Montana.

   b. Monthly Trade Conditions.

III. WAYS AND MEANS

The program of investigations proposed for 1927 and the other activities of the office can be carried with an allotment from Products funds of $13,720. This is an increase of $260 over the allotment for the fiscal year 1927 and is needed to cover salary increases to that amount.

GRAZING INVESTIGATIONS

The status of grazing investigative projects in the District is as follows:

Madison

The field work on the investigations being conducted on this Forest was completed the past season but the final report has not yet been received. Mr. McGinnies is compiling it at the University of Arizona and until it is available no results can be given.

Custer

Poker Jim Experimental Pasture (Administrative experiment).

General conclusions only can be given at this time since all of the detailed compilation is not complete.

Results 1926

1 - Forage-acre requirement (breeding herd) .887 forage acres per cow-month.

2.- Breeding herd showed calf production at time of leaving pasture:

1925 - 156 head	--	65.4%	calf crop
1926 - 121 "	--	41.4%	" "
		24.0%	loss first year

This herd, when taken for the experiment, had been irregularly bred and had dropped calves throughout the year. In 1925 the bulls were in during the time they were in the pasture only, and cows having late calves did not breed that season. Since there were quite a number of these the calf crop in 1926 suffered a reduction. These cows should have bred in the pasture this year, promising an increase in calves in 1927.

Conclusion

That in bringing an irregular breeding herd back to normal, even-aged calf production, the operator will suffer a loss the first year. Eventually this experiment will show the length of time and variation of calf production necessary to bring an irregular breeding herd to normal production.

3 - 11.8% more cow-months' feed was obtained in the pasture in 1926 and in 1925.

4 - This was due directly to several factors:

necessity be added to this program, while some of those assigned may be forced aside by the more urgent need of others.

To touch upon the problems of forest entomology, for which solutions will undoubtedly be demanded in the future, would not only be tiresome but irrelevant. There are, however, a few problems which are of such economic importance as to justify mentioning in this memorandum and to warrant study as soon as possible. In brief, these are the relationship which logging slash, insect-killed trees, windfalls, etc., bear toward the damage to fire-killed white pine by woodborers; the interrelation of forest-fire and insect damage and the ecology of forest types following insect infestations.

OFFICE OF BLISTER RUST CONTROL

The following is the statement made by Mr. S. N. Wyckoff to the District Investigative Committee.

The Office of Blister Rust Control is conducting three major projects in District 1 and adjacent territory. These are: experimental Ribes eradication; reconnaissance of white pine areas; studies in Ribes ecology.

Experimental Eradication by Hand Pulling

The purpose is to develop methods of protection of white pine from white pine blister rust by means of eradication of wild Ribes, which will be applicable to forestry conditions in the western white pine type. The experimental area was located on the Kaniksu National Forest including all or part of Sections 15, 16, 17, 18, 19, 20, 21, 22, 28, 29, 30, 31, 32, 35, 36, Township 60 N., Range 5 W., Sections 1, 2, 3, 11, 12, 13, 14, Township 59 N., Range 5 W., Sections 6, 7, 18, Township 59 N., R. 4 W. This area contained a high percentage of white pine type of varying age-classes, and also three species of Ribes; R. lacustre, R. viscosissimum and Grossularia inermis.

The following table gives the results of this experimental work, in terms of eradication types and costs (strip checks show an efficiency of 93% for the work):

Eradication Type	Ribes Per Acre: R. lacustre	R. viscosissimum	G. inermis	Total	Acreage Worked	Cost Per Acre
Dense Mature	2	-	-	2	465	$ .32
Dense Pole	6	1	-	7	1612	.53
Dense Reproduction	15	1	-	16	940	1.13
Open Mature	10	-	-	10	573	.69
Open Pole	8	20	-	28	4301	.80
Open Reproduction	11	3	-	14	472	.83
Stream	267	9	159	435	502	9.87
Totals & Averages	23	10	10	43	8865	$1.26

It is proposed for the field season of 1927 to conduct a similar experiment, on a somewhat increased scale, on one of the National Forests of Northern Idaho. It was originally intended to carry on such work on the Kaniksu National Forest, but the area first chosen has since been burned over. Suggestions are invited from the Forest Service as to a suitable location for this work.

Experimental Eradication by Application of Chemicals

The purpose is to develop chemical methods of Ribes eradication which may be less expensive than hand-pulling. It is expected that this method of eradication will be particularly applicable in areas where Ribes growth is most profuse. The work has been conducted on these areas in 1925 and 1926: Lake Creek, near Wallace, Idaho; Santa Creek on the North Fork near St. Maries River, Idaho. The results to date indicate that R. petiolare, and probably other species, can be eradicated by application of chemicals more cheaply and efficiently than by hand-pulling where these plants occur in great numbers in the Stream Type.

It is proposed to conduct further experimental work in 1927 along the following lines: (1) Study of methods of application of chemicals, including investigation of possible use of small power units; (2) Experimental application of new chemicals, and (3) Rechecking of areas sprayed in 1925 and 1926.

Reconnaissance of White Pine Areas

The Office of Blister Rust Control is conducting an extensive reconnaissance of white pine areas to determine the average density of Ribes flora, and the general occurrence of the eradication types. The purpose is to secure information for the development of a general plan for application of local control of blister rust. Since the inception of the work over 500,000 acres of land on National Forests, and over 200,000 acres in private ownership, have been reconnaissanced.

It is proposed to continue this reconnaissance until a general conception of local control conditions in the white pine type has been secured. Information from the Forest Service regarding definite location of areas of white pine type is of great assistance in this work.

Studies in Ribes Ecology

The purpose is to secure information on the occurrence, habits of growth, means of seed dissemination, and factors influencing establishment and survival of Ribes seedlings. Such information is desired: (1) to determine best methods of Ribes eradication, and (2) to determine the possibility of permanently decreasing the Ribes flora of white pine stands by means other than eradication. To date numerous sample plots in various parts of the white pine belt have been established, on which Ribes establishment, survival and rate of growth are being studied.

It is proposed to recheck existing plots in 1927, and to establish new ones. Through the co-operation of Mr. Weidman, Ribes study plots will be established on some of the permanent sample plots of the Experiment Station.

Further Co-operation Desired from the Forest Service

The presence of a well-established focus of pine infection at Nelson, British Columbia, means that advance infections of white pine blister rust may at any time be found in Northern Idaho and the adjacent white pine areas. Local control of blister rust is most effective when conducted in advance of such infection; if control is delayed until the rust is actually present, damage to pine invariably results. In order to properly plan for such control work, this Office is in great need of a careful and accurate inventory of all white pine lands. The decision as to where local control is to be applied can be made only by the pine owners themselves. Such an inventory and resultant decision by the pine owners would distinctly narrow the objective of this Office, and render its work more productive. In order to meet this situation the Forest Service should at once undertake and carry to completion as rapidly as possible a careful delimitation of the areas which they wish to permanently develop as white pine type, and studies on rate of growth of white pine which will make possible the prediction of yield of white pine from reproduction stands of various ages, density, and composition. Such studies will not only constitute a sound basis for application of local control on the National Forests, but will also exert a beneficial influence on the development of local control outside the National Forests. The need for such studies is very great, and this Office most earnestly recommends that they be undertaken at the earliest possible moment.

The District Investigative Committee gave this question considerable discussion. The prevailing opinion was that it would be practically impossible to make a classification of the white pine type of the sort desired. The feeling of the Committee finally was that local control should be given to the entire area of the white pine type including stands containing 13 per cent and more white pine. The area of the white pine type in District 1 is close to two million acres.

The needs from the standpoint of yield prediction in young stands will be materially met when the Experiment Station completes its normal-yield tables this spring. Considerable additional yield study in very young stands is needed, however, to determine definitely the changes in ratio of white pine to other species with the increasing age of the stands. This is more of a job than the Experiment Station can handle with its present funds. A plan for financing the study from Blister Rust funds was outlined in last year's Investigative program.

FOREST RESEARCH PROJECTS IN 1927

UNIVERSITY OF IDAHO

1. Permanent Sample Plots in Residual White Pine Stands.
   C. W. Watson.

2. Study of Residual Yellow Pine Stands after Logging.
   C. W. Watson.

3. Permanent Yield Plots in Western White Pine.
   H. I. Nettleton.

4. Permanent Yield Plots in Western Yellow Pine.
   H. I. Nettleton.

5. Chemical Weed Eradication in the Nursery. C. W. Watson.

6. Value of Shading Seedbeds. C. W. Watson.

7. Value of Mulching Seedbeds. C. W. Watson.

8. Effect of Size of Trees Harvested on Logging Costs.
   E. G. Wiesehuegel.

9. Value of Farm Windbreaks. Assignment later.

10. Ribes Studies in Co-operation with Office of Blister Rust Control: (1) Influence of burns on Ribes occurrence; (2) Germination tests of Ribes seeds; (3) Determine whether Ribes seed is stored in duff. E. E. Hubert.

11. Studies in Co-operation with Industry and Forest Service to determine cull per cent due to rot in standing timber, to determine deterioration of logs in storage, and to ascertain the efficiency of chemical end coatings on logs left in the woods or stored. E. E. Hubert.

12. Outward signs of decay in standing timber leading to publication of "Handbook of Wood Rots for Cruisers and Scalers" in 1927. E. E. Hubert.

13. The following laboratory projects are conducted by E.E. Hubert:

    (a) Suitability of western red cedar for cigar-box stock in co-operation with Weyerhaeuser Sales Co. & cigar box manufacturers.

    (b) Studies in decay resistance (durability) of native woods in co-operation with Western Pine Manufacturers Association. Decay organisms have been isolated so far for decayed sash, door, and screen parts.

(c) Moisture content of "bull pine" and "yellow pine" in co-operation with Boise-Payette Lbr. Co.

(d) Cause and control of kiln brown stain in lumber in co-operation with Western Pine Manufacturers Association and local mills.

(e) Thermal conductivity of wood at various moisture contents. Project conducted by Dean M. F. Angell of Physics Department.

(f) Factors influencing the movement of moisture in wood.

(g) Relation of shrinkage and swelling to moisture content of wood.

(h) Utilization of blued match stock.

(i) Inflammability and heat retention of various forest fuels at different moisture contents.

FOREST RESEARCH PROJECTS IN 1927

UNIVERSITY OF MONTANA

1. Factors underlying seed production and viability of forage plants in relation to range management. In co-operation with the Forest Service. T. C. Spaulding.

2. Shrinkage of woods native to Western Montana from a green to an oven-dry condition. J. H. Ramskill.

3. Electrical measurement of moisture content of wood. J. H. Ramskill with co-operation G. D. Shallenberger of the Physics Department.

4. Effect of alignment, curvature, grade, slant of trough, and super-elevation in log chutes. I. W. Cook.

5. Observations in cut-over stands of the larch-fir type in the Stillwater State Forest. Dorr Skeels.

6. Observations in cut-over yellow pine stands in the Fort Missoula Military Reservation. Dorr Skeels.

7. Studies in seed testing. Dorr Skeels.

8. Test of exotic species for forest and shade tree planting in Montana. Dorr Skeels.

9. Periodic measurement of several permanent-yield plots in western yellow pine. Dorr Skeels.

10. Factors that might affect rate of spread of white pine blister rust in Montana. In co-operation with Office of Blister Rust Control. Dorr Skeels.

11. Grazing and fire damage in yellow pine and Douglas fir types. Dorr Skeels.

RELATIVE URGENCY OF EXPERIMENT STATION PROJECTS

Only the major projects are listed; other projects requiring incidental attention during the year are not here considered.

Group	Project	Relative Urgency
Silvical Studies	Reproduction after Fires	1
	Methods of Cutting	2
	Yield	3
Fire Studies	Weather in Relation to Inflammability	1
	Lightning in Relation to Fires	2
	Co-operation in Weather Forecasting	3
Experimental Centers	Development Priest River Branch	1
	Locate Experiments in Coeur d'Alene Center	2
	Selection of Clearwater Center	3

The assignment of members of the staff to the above projects will be tentatively as follows:

	In Charge	Assistance
Reproduction after Fires		
Establish permanent sample plots.	Marshall	Kempff
Methods of Cutting		
Establish permanent sample plots	Weidman	Kempff
Current examinations existing plots	Weidman	Marshall Gisborne
Yield Studies		
Remeasure and subdivide 8 permanent plots.	Weidman	Marshall
Finish office work Normal Yield Tables	Haig	
Fire Studies	Gisborne	
Priest River Branch	Kempff	
Other Experimental Centers	Weidman	

In 1926 Weidman was able to devote 5 weeks to individual research work in establishing permanent methods-of-cutting plots. In order to prevent Gisborne from becoming restricted too narrowly to his specialized fire research, the aim has been to get him on silvical studies for a while each year. In 1926 this was accomplished by 3 weeks' field work in the fall establishing yield plots.

ARTICLES AND PUBLICATIONS BY EXPERIMENT STATION

Published and Accepted for Publication in 1926

Measuring Forest Fire Danger in Northern Idaho -- H. T. Gisborne.
Accepted for Department Circular.

Lightning and Forest Fires in the Northern Rocky Mountain Region --
H. T. Gisorne. Mo. Weather Review, July, 1926.

Meteorology and Forest Fire Protection -- H. T. Gisborne.
Forestry Kaimin, University of Montana, 1926.

Trend of Forest Fire Research in Northern Idaho -- H. T. Gisborne.
Idaho Forester, University of Idaho, 1926.

Forest Fire -- A Mother of Invention -- H. T. Gisborne.
American Forests & Forest Life, 1926.

More Forest Inventions -- H. T. Gisborne.
American Forests & Forest Life, 1926.

Investigations in Chemical Weed Control at Savenac Nursery --
W. G. Wahlenberg. Accepted for Department Circular.

Age Classes of Western White Pine Planting Stock in Relation to
Aspect of Planting Site -- W. G. Wahlenberg.
Jour. of Agr. Res., October, 1926.

Western Larch Nursery Practice -- W. G. Wahlenberg.
Jour. of Agr. Res., August, 1926.

How to Establish a Windbreak in Montana -- W. G. Wahlenberg.
Montana Farmer, July, 1926.

Some Principles to Guide the Marking Axe in Western Yellow Pine --
R. H. Weidman. Idaho Forester, University of Idaho, 1926.

Proposed for Publication in 1927

Meteorological Factors of the Quartz Creek Fire -- H. T. Gisborne.
Accepted by Mo. Weather Review.

Objectives of Forest Fire Weather Research -- H. T. Gisborne.
Published in Jour. of Forestry, April, 1927.

Results of the Lightning Study in 1926 -- H. T. Gisborne.

Articles on phases of "Measuring Forest Fire Danger" for Trade Journals, to be taken from the Departmental Circular when published -- H. T. Gisborne.

Effect of Ceanothus Brush on Western Yellow Pine Plantations -- W. G. Wahlenberg. Submitted for Jour. of Agr. Res., March, 1927.

Influence of Size of Western Yellow Pine Seeds on Behavior of Forest Planting Material -- W. G. Wahlenberg. Submitted for Jour. of Agr. Res., March, 1927.

Experiments in the Use of Fertilizers at Savenac Nursery. -- W. G. Wahlenberg. Prepared.

Classes of Stock Suitable for Planting in Northern Idaho -- W. G. Wahlenberg and J. A. Larsen. Prepared.

Modification of Western Yellow Pine Root Systems in the Nursery -- W. G. Wahlenberg.

Volume Production in Forestry Literature -- Robert Marshall. Jour. of For., February, 1927.

Influence of Precipitation Cycles on Forestry -- Robert Marshall. Published in Jour. of For., April, 1927.

Life History of Certain Western White Pine Stands -- Robert Marshall.

Western White Pine Yield Study -- I. T. Haig.

Results of Thinning Experiments in Western White Pine -- Gerhard Kempff.

Timber Growing and Logging Practice in Western Yellow Pine in the Northwest -- R. H. Weidman.

Results on Permanent Sample Plots in Western Yellow Pine Ten Years After Cutting -- R. H. Weidman.

Western Yellow Pine in the Northwest -- R. H. Weidman. To be prepared as a bulletin.

Conifers of the Northern Rocky Mountains -- J. A. Larsen.

Forest Types in the Northern Rocky Mountains and Their Climatic Controls -- J. A. Larsen.

EXPERIMENT STATION STAFF

R. H. Weidman	Director
H. T. Gisborne	Associate Silviculturist
I. T. Haig	Assistant Silviculturist
G. Kempff	Junior Forester
R. Marshall	Junior Forester
Margaret H. Troop	Clerk

EXPERIMENT STATION BUDGET F.Y. 1928

	S.I.	GE D-1	Planting	Imp.
Salaries (permanent staff)	$11,300	$3,660	$666.68	
Expenses (" ")	2,300			
Rent	660			
Maint. & oper. 2 autos	250			
Equipment and supplies	250			
Freight, express & hauling	100			
Field assistants (salary & ~~equip.~~ expense)	680°		150.	
Maint. & adm. branch station		285		$476
Maint. team of horses	$	200		
	$15,540	$4,145	$816.68	$476

° This amount is merely the balance after all other necessary items have been provided for out of the present total S.I. allotment. It is not sufficient to cover the needs for temporary field assistants, which for next year will be $1400 (to provide for a minimum of 11 man-months for salaries and subsistence).